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Environmental Impact Analysis as a Tool for Environmentally sound Development

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1 Introduction

All human activities cause environmental burdens. The question is whether these burdens are necessary and how great they will be.

The amount of environmental impact of a system -- either a civil or military one -- is defined in the development process. So it is important to take environmental issues into account as early as possible in this process.

Environmental issues must be an integral part of every development.

The environmental guideline in the procurement process is to develop and to obtain defence materiel that fulfils the military and technical requirements and pollutes the environment as little as possible.

For military items, the main emphasis is on operation and disposal during peacetime.

The environmental issues during the procurement process can be summarised in the following goals:

- Saving of energy,
- preservation of resources,
- prevention and disposability of waste,
- reduction of emissions,
- replacement of hazardous and radioactive materials,
- preservation of bodies of water,
- prevention of soil contamination.

These aspects which are very broad will be taken into account during the whole process.

Throughout the whole process environmental considerations should be on par with other considerations, such as effectiveness, quality, military life-cycle costs, and terms of delivery.

2 The Environmental Impact Analysis (EIA) as a Management Tool

During the development of a complex system it is necessary to find a good way to include all environmental aspects. The EIA is a management tool that encompasses all the relevant issues.

This analysis has the following purposes:

- to pinpoint the essential **burdens on the environment** which will be associated with the defence materiel being developed,
- to identify the pertinent **legal, administrative or technical provisions** concerning the acquisition program,
- to furnish proof that the identified burdens meet these provisions,
- to examine possibilities of reducing environmental impacts even below allowed legal limits,
- to bring about necessary decisions by supervisory authorities (approvals, permits)
- to point out that the chosen approach is environmentally compatible compared to alternative solutions,

- to point out which measures have already been taken to achieve environmental compatibility,
- to point out **measures** which **remain** to be taken to establish environmental compatibility as well as the corresponding time schedules,
- to point out remaining risks,
- to point out additional measures which have to be taken by someone else (e.g. infrastructural measures or matters of training) and preconditions or necessary constraints for the future operation of the defence materiel which have to be taken into account by the user,
- documentation of relevant information about the materiel.

Subjects of the environmental-impact-analysis with respect to defence materiel's life-cycles are:

– development:	+	design, technical tests, service tests
– procurement:	+	production
– in-service phase:	+	operation, training,
	+	storage, transport
	+	maintenance, preservation
– disposal process:	+	further utilisation, recycling, disposal

The main emphasis has to be put on operation and disposal during peace time

Some of the EIA purposes will be discussed in more detail in the following paragraphs.

2.1 Identification of essential environmental burdens

In a complex system like a main battle tank there are a lot of environmental impacts. In this case, the task of the EIA is to identify the essential ones. This step has to be done very early, so that during the following steps the focus can be set in the right direction. It is not very useful to invest a lot of work in the use of a lithium battery, when in the same munitions toxic gases will be produced during the launching process.

2.2 Legal requirements

In our communities, the military must obey the law. In Germany, the armed forces also must adhere to environmental legislation. Exemptions for military reasons are defined in the laws if necessary. The ability to use these exemptions is very restricted.

So it is important to find out which legislation can be relevant for the materiel in its in-service phase. Especially when systems are used in ecologically sensitive areas, there may be a lot of specific requirements pertaining to the system's construction. If these regulations are not identified and the materiel is not designed to meet these requirements, it may cause restrictions in use or more severe results. In the best case, it is possible to refit the materiel but this will lead to very high additional costs and efforts.

The EIA has the purpose of identifying the relevant regulations and also documenting the observance of legal, administrative or technical provisions.

2.3 Environmental data

For the environmentally sound use of materiel in the in-service phase, some data and information are essential. The EIA has the task of producing and collecting them during development. There are two large classes of data that are important. The first group is data about hazardous and environmentally relevant items. The second is information about the disposal of spare parts or the whole system. All this information should be integrated into the logistic information, because the processes with greatest environmental relevance during the in-service phase are logistical ones.

2.3.1 Data about hazardous and environmentally relevant items

Military systems are in service for a long time. In this period legislation often changes to become more restrictive. For example, 20 years ago asbestos was a favorite materiel for a variety of applications. Today it is forbidden in many countries. If during development no documentation is prepared which deals with this problem, it will cost a lot of money, time and energy to get this information. We have some experience in finding substitutes for now forbidden or banned materiel. The greatest problem was identifying the relevant parts. With good documentation, this job will be easier. It is the responsibility of the project manager to find the right solution: having reviewed an extensive list of all used materiel, he must make a concerted effort to identify relevant materiel. A good way to collect all relevant information is a "List of hazardous and environmental relevant items" which includes all information about HazMat, LASER, radioactive items, etc. This list should be a document or better database, which will help the management during the use of the materiel to check the system.

2.3.2 Concept of disposal

At the end of every life cycle the materiel has to be disposed. "Disposal" includes all methods to get rid of something, such as recycling, reuse, dismantling or deposition at a landfill. During development, it is necessary to check what can be done with the system components at the end of the life cycle. So it would be useful to prepare a "Concept for disposal" which includes the information about:

- waste being obtained during the in-service phase or, in case of disposal, of the defence materiel being developed,
- the classification of this waste with respect to the law pertaining to possible disposal methods,
- how these methods correspond to legislation,
- preconditions for handling the materiel over to anyone else (e.g. bans on putting it into the market).

This Concept has to be updated during the in-service phase from time to time, because legislation, especially in the area of waste management, changes.

2.4 Environmental issues in the documentation

At the end of the development, a lot of information including certificates, restrictions and special advice for an environmentally sound use of the materiel will hopefully be collected and available. All this information must be not only available to the management (perhaps as "fileware" which means as paper in the file cabinet). It is important to bring this information to the customer or user. Therefore all relevant hints or restrictions or measures must be integrated into the user manuals.

3 The EIA as tool to estimate and minimize the Life Cycle cost

In most management systems for the development of materiel, life cycle costs have a great weight, because the materiel will be used for a long period. For example in the life cycle of a washing machine, which is scheduled by industry for 10 years, 90% of the complete used energy is used during the "in-service phase".

The life cycle cost analysis normally deals with costs, which can be identified easily, or which are clear to everyone. In the environmental sector, there a lot of "hidden" costs, which cannot be directly assigned to a process. These costs are caused by enforced actions especially when HazMat is in the loop.

For Example: For the handling of HazMat, many regulations must be followed. The more hazardous the materiel is, the higher the regulations and therefore the expenditure will be. Some of these costs are

- Transport (HazMat transport is more difficult to manage, or it is permitted to transport only small quantities)
- Storage (for HazMat special storage requirements are given)
- Infrastructure (You need specially designed and built stores or workshops)
- Use and handling (for HazMat there are sometimes special requirements for documentation, who had contact with the HazMat, and so on. Perhaps the use is connected with a special license)
- Disposal (HazMat is expensive to dispose of)

These are only the foreseeable costs, which cannot be assigned exclusively to one defined process. But there are a lot costs that are not included here, and will not be identified on the first look such as:

- Higher rate of illness
- More medical check ups
- More control, surveillance and checks (also from other government agencies)
- More protection requirements (perhaps special protection clothing)
- More technical expenditure (such as special filter equipment, which will also produce costs in maintenance such as changing the filter, and disposing of the used filters as HazMat)
- More training efforts to fulfil the requirements.

In the United States (ARDEC Industrial Ecological Center Picatinny Arsenal New Jersey) a lot of basic work in the area of environmental cost analysis has been done.

During development, a comparison of alternatives should include these considerations, in addition to the purely environmental ones like emissions, etc. A supposed cheap solution can, in the end, become a very expensive one.

Comparison of alternatives is an important task of the EIA. For this mission it is not necessary to create a full Eco balance. This will be very difficult and is, in my opinion sometimes a "religious" question, especially when different environmental impacts must be compared or balanced. For example: Is it environmentally more friendly to cut woods somewhere to produce a natural-based thinner, or it is better to produce a thinner in a chemical plant? It seems to be a good approach to make a kind of "gate to grave" analysis, because these life cycle parts can be influenced by the developer.

To analyze the environmental impacts during the life cycle, computer programs are available on the market. These are Eco balance software programs. Some of them also include financial aspects, so it is possible to compare the environmental benefit to other possible costs during the system's life time. It also will show the cost drivers in the process. There is

only one handicap: the costs for the relevant components such as work, infrastructure etc. must be available. In official services, it is often very difficult to find out these data.

4 The EIA as a Software Tool

The EIA is a process with changing objectives during the development of a product. It seems to me, based on my experience, that a unique software tool to produce an EIA is not useful. However Software to assist the individual tasks is necessary.

A very important part of the "software environment" is a database for legislation. In the environmental sector, the volume of legislation is tremendous, especially when all regulations and technical specifications are included. (In Germany we have over 800 laws in the environmental sector alone.) Such software is normally available on the market.

Also, information about Hazardous Materiel is needed.

It is also useful to have software to prepare a life cycle cost analysis, as mentioned earlier. Such software is also available on the market.

To document environmentally relevant data and information, a database should be used. The design of this database depends on the system which is used to assist the logistic processes in the armed services. In Germany, we are creating a Database which focuses on the Project with interfaces to central information systems, including NATO cataloguing programs. The database will be a small Microsoft Access solution.

5 Conclusions

The EIA can be the central management tool for environmental considerations during the development of a new system. The EIA changes its focus during the whole process from a more qualitative objective in the beginning of the development to one of documentation of the remaining environmental impacts and data with steps to optimize the environmental impacts in-between. It is also a tool to estimate the environmental life cycle including the cost aspects, and therefore it will help determine the right decisions.

In the end, to paraphrase an old Indian proverb:

We have not inherited the earth from our ancestors; we have borrowed it from our children.